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(54) [Title of the Invention] Manufacturing Method of Reflective Type Liquid Crystal Display Device

(57) [Summary]

[Purpose] The invention relates to a manufacturing method of a reflective type liquid crystal

display device, in which Al is used for a reflective electrode film and ITO is used for a connecting electrode, and further the invention has no problem of corrosion and dissolution due to a battery effect caused by a developer when forming a mask used for patterning the reflective electrode film even in the case where the reflective electrode film has a pin hole.

[Structure] A resist film 34 is formed with a TFT portion covered with a passivation film 30 in which a through hole 30A is formed which exposes a portion of a source electrode 28S, a gate terminal portion which exposes a connecting electrode 32G, and a drain terminal portion which exposes a connecting electrode 32D. The resist film 34 is exposed and developed to form an aperture 34A of a reflective electrode pattern, which exposes the through hole 30A, a reflective electrode film 35 is formed over the resist film 34 including the aperture 34A, and the resist film 34 is peeled off together with the reflective electrode film 35 thereover; thereby a reflective electrode contacting the source electrode 28S is obtained.

[Scope of Claim]

[Claim 1] A manufacturing method of a reflective type liquid crystal display device in a process of manufacturing a TFT substrate, comprising:

forming a resist film over a whole surface with a TFT portion covered with a passivation film in which a through hole is formed which exposes a portion of a source electrode, a gate terminal portion which exposes a connecting electrode, and a drain terminal portion which exposes a connecting electrode;

forming an aperture of a reflective electrode pattern which exposes the through hole by exposing and developing the resist film;

forming a reflective electrode film over the resist film including the aperture of the reflective electrode pattern; and

forming a reflective electrode contacting the source electrode by peeling off the resist film together with the reflective electrode film thereover.

[Claim 2] The manufacturing method of a reflective type liquid crystal display device, according to claim 1, comprising:

forming an aperture of a reflective electrode pattern and an aperture of a light shielding film pattern which expose a through hole by exposing and developing the resist film;

forming a reflective electrode film over the resist film including the aperture of the reflective electrode pattern and the aperture of the light shielding film pattern; and

peeling off the resist film together with the reflective electrode film thereover and simultaneously forming a reflective electrode contacting the source electrode and a light shielding film for suppressing light leakage into the TFT.

[Claim 3] The manufacturing method of a reflective type liquid crystal display device, according to claim 1 or 2,

wherein ITO is used as a material of the connecting electrode and Al is used as a material of the reflective electrode.

[Detailed Description of the Invention]

[0001]

[Technical Field to which the Invention Pertains] The invention relates to a method for manufacturing a reflective type liquid crystal display device having a structure which is improved so that parallax hardly occurs.

[0002] At present, a reflective type liquid crystal display device has a structure having a reflective layer provided inside a cell as a countermeasure against parallax which easily occurs due to a thickness of a back glass substrate when a reflective board is provided outside a cell.

[0003] In that case, however, damage is caused during or after the manufacture, which leads to the reduction in manufacturing yield or degradation of reliability. Therefore, this problem is required to be improved and can be solved by the invention.

[0004]

[Related Art] FIG. 18 is a schematic plan view showing a TFT (tin filmtransistor) substrate of a standard reflective type liquid crystal display device.

[0005] In the view, 1 denotes a transparent insulating substrate (glass substrate), 2 denotes a TFT region, 3 denotes a gate terminal, and 4 denotes a drain terminal.

[0006] FIG. 19 is a schematic plan view showing an enlarged portion of the TFT region shown in FIG. 18, which shows a certain pixel as a center and the vicinity thereof.

[0007] In the view, 11 denotes a gate electrode wire, 11A denotes a gate electrode, 12 denotes a drain electrode wire, 12A denotes a drain electrode, 13 denotes a source electrode, 13A denotes a

though hole, and 14 denotes a pixel electrode (reflective electrode).

[0008] FIG. 20 is a schematic plan view showing an enlarged portion of the terminal shown in FIG. 18. (A) shows a gate terminal portion and (B) shows a drain terminal portion, in which the same symbols used in FIG. 19 denote the same portions or have the same meanings.

[0009] In the view, 15 denotes a connecting electrode with an external element, 16 denotes a though hole, 17 denotes a connecting electrode with an external element, and 18 denotes a through hole.

[0010] A reflective type liquid crystal display device provided with a reflective layer inside a cell can be obtained if the pixel electrode 14 functions as a reflective electrode in the TFT substrate described in FIGS. 18 to 20. Next, steps of forming a TFT substrate having such a structure are described.

[0011] FIGS. 21 to 23 are schematic sectional side views showing a TFT substrate at key points of steps for describing the steps of manufacturing the TFT substrate described in FIGS. 18 to 20. Hereinafter, description will be made with reference to these views and the like.

[0012] However, in any view, a (TFT portion) is shown in a view in which the TFT portion shown in FIG. 19 is cut along a line X-X, a (gate terminal portion) is shown in a view in which the gate terminal portion shown in FIG. 20(A) is cut along a line Y-Y, and a (drain terminal portion) is shown in a view in which the drain terminal portion shown in FIG. 20(B) is cut along a line X-X.

[0013] Steps up to forming the structure of the TFT substrate shown in FIG. 21 are exactly the same as the steps of an embodiment of the invention describing FIGS. 1 to 13(A) except for forming the reflective electrode film 35; therefore, those views and descriptions are to be referred.

[0014] Refer FIG. 21(A).

21-(1)

A state of the shown TFT substrate is,

[0015] <1> in the (TFT portion),

a gate electrode 22G is formed over an insulating transparent substrate 21, a gate insulating film 24 covers the gate electrode 22G, an active layer 25 is formed over the gate insulating film 24, a channel protective film 26 is formed over the active layer 25 corresponding to the gate electrode 22G, a drain electrode 28D and a source electrode 28S are formed facing each other with the

channel protective film 26 sandwiched therebetween, the passivation film 30 having an aperture is formed over the source electrode 28S over those and the like, and the reflective electrode film 35 contacting the source electrode 28S through the aperture is formed over the passivation film 30.

[0016] <2> In the (gate terminal portion),

a gate electrode wire 22L is formed over the insulating transparent substrate 21, over which is covered with the gate insulating film 24 having an aperture over the gate electrode wire 22L and the passivation film 30 also having an aperture. The connecting electrode 32G contacting the gate electrode wire 22L through the aperture is formed over the passivation film 30, over which is covered with the reflective electrode film 35.

[0017] <3> In the (drain terminal portion),

the insulating transparent substrate 21 is covered with the gate insulating film 24, a drain electrode wire 28L is formed over the gate insulating film 24 with the active layer 25 as a base, over which is covered with the passivation film 30 having an aperture over the drain electrode wire 28L. The connecting electrode 32D contacting the gate electrode wire 28L through the aperture is formed over the passivation film 30, over which is covered with the reflective electrode film 35.

[0018] Now, description is made on the formation of the reflective electrode film 35 which leads to the steps describing FIGS. 1 to 13 of an embodiment of the invention.

[0019] 21-(2)

The reflective electrode film 35 formed of Al or Ag is formed by employing a vacuum evaporation method.

[0020] Refer FIG. 21(B)

21-(3)

By employing a spin coating method, a resist film 36 is formed by applying resist over the reflective electrode film 35.

[0021] Refer FIG. 22(A)

22-(1)

By employing a resist process of a lithography technique, the resist film 36 is exposed and developed; thereby the reflective electrode is patterned in the TFT portion.

It is to be noted that the resist film is not left in the gate terminal portion and the drain terminal

portion.

[0022] Refer FIG. 22(B)

22-(2)

The reflective film 35 is etched by using the patterned resist film 36 as a mask; thereby a reflective electrode 35R is formed in the TFT portion. It is to be noted that the reflective electrode film 35 in the gate terminal portion and the drain terminal portion is removed.

[0023] Refer FIG. 23

23-(1)

The resist film 36 used as a mask for etching the reflective electrode film 35 is removed by dipping it in a resist stripping solution or the like.

[0024] As a result, the reflective electrode 35R contacting the source electrode 28S is exposed in the TFT portion and the connecting electrodes 32G and 32D are exposed in the gate terminal portion and the drain terminal portion.

[0025]

[Problems to be Solved by the Invention] In the steps of the conventional technique described above, the reflective electrode film 35 is etched into the reflective electrode 35R by employing a wet etching method using an etching solution formed of nitric acid, acetic acid, phosphoric acid, and water as an etchant.

[0026] It is needless to say that the reflective electrode 35R is favorably formed of a material with high reflectivity, and in that sense Ag is optimum. However, Ag has high diffusivity; therefore, it is highly possible that Ag is diffused or reacts against the base.

[0027] On the other hand, Al has less possibility of being diffused or reacting against the base, is widely used for metallization in an integrated circuit, and has favorable characteristics such as an etching condition. Thus, Al is often used for the reflective electrode 35R.

[0028] In the description of the steps 21-(1) to 22-(2) of the conventional technique describing FIGS. 21 to 23, the reflective electrode film 35 formed of Al is deposited over the connecting electrodes 32G and 32D which are formed of ITO and the reflective electrode film 35 undergoes wet etching as described above.

[0029] In general, a thin film has a lot more lattice defects than a substance in a bulk state and has

imperfect crystals. Therefore, the reflective electrode film 35 has many pin holes.

[0030] FIG. 24 shows a schematic sectional side view showing an enlarged portion surrounded by a broken line in FIG. 21(B). The same symbols used in FIG. 21 denote the same portions or have the same meanings.

[0031] In the view, 35P denotes a pin hole generated in the reflective electrode film 35 formed over the connecting electrode 32G or 32D formed of ITO.

[0032] In the case of exposing and developing the resist film 36 in the shown state, the developer simultaneously contacts both the reflective electrode film 35 and the connecting electrode 32G or 32D.

[0033] As described above, when the reflective electrode film 35 is formed of Al and the connecting electrode 32G or 32D is formed of ITO, a battery effect occurs through the developer and thus corrosion and dissolution occur by the reaction of Al and ITO. This was found out to surely reduce the manufacturing yield of TFT and consequently the manufacturing yield of the reflective type liquid crystal display device.

[0034] In the invention, even in the case where Al is used for the reflective electrode film, ITO is used for the connecting electrode, and further the reflective electrode film has a pin hole, the invention is free from a problem of corrosion and dissolution caused by a developer when forming a mask used for patterning the reflective electrode film even in the case where the reflective electrode film has a pin hole.

[0035]

[Means for Solving the Problem] In the invention, a lift-off method is employed when forming a reflective electrode by patterning the reflective electrode film. While forming a mask for the lift-off process by exposure and development of a resist process of the lithography technique, it is a basic state that the gate terminal portion and the drain terminal portion are necessarily covered with the resist film.

[0036] As described above, in the manufacturing method of the reflective type liquid crystal display device of the invention,

(1) The process of manufacturing a TFT substrate includes a step of forming a resist film (for example, the resist film 34) over a whole surface with a TFT portion (for example, (the TFT

portion) in each view) covered with a passivation film (for example, the passivation film 30) in which a through hole (for example, the through hole 30A) which exposes a portion of the source electrode (for example, the source electrode 28S) is formed, a gate terminal portion (for example, (the gate terminal portion) in each view) which exposes a connecting electrode (for example, the connecting electrode 32G), and a drain terminal portion (for example, (the drain terminal portion)) which exposes a connecting electrode (for example, the connecting electrode 32D), a step of forming an aperture (for example, the aperture 34A) of a reflective electrode pattern which exposes the through hole by exposing and developing the resist film, a step of forming a reflective electrode film (for example, the reflective electrode film 35) over the resist film including an aperture of the reflective electrode pattern, a step of forming a reflective electrode (for example, the reflective electrode 35R) which contacts the source electrode by peeling off (lift-off) the resist film together with the reflective electrode film thereover. Alternatively,

[0037] (2) in the aforementioned description (1), a step of forming an aperture of a reflective electrode pattern and an aperture of a light shielding pattern which expose a through hole by exposing and developing the resist film, a step of forming a reflective electrode pattern over the resist film including the aperture of the reflective electrode pattern and the aperture of the light shielding pattern (for example, the aperture 34B of the light shielding pattern), and a step of simultaneously forming a reflective electrode which contacts the source electrode and a light shielding film (for example, the light shielding film 35C) which suppresses light leakage into the TFT by peeling off the resist film together with the reflective electrode film thereover. Alternatively,

[0038] (3) in the aforementioned description (1) or (2), the connecting electrode is formed of ITO and the reflective electrode is formed of Al.

[0039]

[Effect] By employing the aforementioned means, there is no possibility in that the resist film is developed with the reflective electrode film and the connecting electrode contacting each other. Therefore, corrosion and dissolution due to a battery effect do not occur even when the reflective electrode film is formed of Al and the connecting electrode in the gate terminal portion and the drain terminal portion is formed of ITO. Thus, manufacturing yield of the reflective type liquid

crystal display device which is controlled by TFT arrays is improved.

[0040]

[Embodiments] FIGS. 1 to 15 show schematic sectional side views each showing a TFT substrate at key points of steps for describing the steps for manufacturing a TFT substrate used for the reflective type liquid crystal display device as Embodiment 1 of the invention. Hereinafter, description is made with reference to these views and the like.

[0041] In these views and the like, the (TFT portion) is a view similar to the TFT portion in FIG. 19 cut along a line X-X, the (gate terminal portion) is a view similar to the gate terminal portion in FIG. 20(A) cut along a line Y-Y, and the (drain terminal portion) is a view similar to the drain terminal portion in FIG. 20(B) cut along a line X-X.

[0042] Refer FIG. 1(A)

1-(1)

The insulating transparent substrate 21 used for a normal liquid crystal display device is prepared. Glass is generally used as a material of this insulating transparent substrate 21; however, a Si wafer, plastic, or the like can also be used instead.

[0043] 1-(2)

A gate electrode material film 22 is formed over the insulating transparent substrate 21. A conductive substance such as Al, Ti, and Cr can be used as this gate electrode material film 22. Further, as a deposition technique, a vacuum evaporation method, a sputtering method, a chemical vapor deposition (CVD) method, or the like can be employed.

[0044] Refer FIG. 1(B)

1-(3)

By employing a spin coating method, a resist film 23 is formed by applying resist over the gate electrode material film 22.

[0045] Refer FIG. 2(A)

2-(1)

By employing a resist process of the lithography technique, the resist film 23 is exposed and developed; thereby a gate electrode wire is patterned as a gate electrode and a gate bus line. It is to be noted that a resist film is not left in the drain terminal portion.

[0046] Refer FIG. 2(B)

2-(2)

The gate electrode material film 22 is etched using the patterned resist film 23 as a mask; thereby the gate electrode 22G and the gate electrode wire 22L are formed in the TFT portion and the gate terminal portion respectively.

[0047] In order to etch the gate electrode material film 22, depending on the material thereof, a wet etching method using an HCl-based etching solution, a hydrofluoric acid-based etching solution, or the like as an etchant or a reactive ion etching (RIE) method using a CF_4-based gas, a CCl_4-based gas, or the like as an etching gas can be employed.

[0048] Refer FIG. 3(A)

3-(1)

The resist film 23 used as a mask for etching the gate electrode material film 22 is removed by dipping it in a resist stripping solution and applying ultrasonic wave. As a result, the gate electrode 22G and the gate electrode wire 22L are exposed but nothing is left in the drain terminal portion. Therefore, the insulating transparent substrate 21 remains as it is.

[0049] Refer FIG. 3(B)

3-(2)

By employing the CVD method, the gate insulating film 24 is formed over the whole surface. This gate insulating film 24 can be formed of SiN, SiO_2, or the like.

[0050] 3-(3)

By employing the CVD method, the active layer 25 is formed over the whole surface. This active layer 25 may be formed of Si.

[0051] 3-(4)

For example, by employing the ion implantation method, n-type impurity ions or p-type impurity ions are implanted into the active layer 25 to make the active layer 25 conductive. It is to be noted that the impurity activating heat treatment may be performed independently or together with other heat treatment in an appropriate phase.

[0052] 3-(5)

By employing the CVD method, a channel protective film 26 is formed. This channel protective

film 26 can be formed of SiN, SiO_2, or the like.

[0053] Refer FIG. 4(A)

4-(1)

By employing the spin coating method, a resist is applied over the channel protective film 26; thereby a resist film 27 is formed.

[0054] Refer FIG. 4(B)

4-(2)

By employing a resist process of the lithography technique, the resist film 27 is exposed and developed; thereby an actual channel protective film of the TFT is patterned. It is to be noted that the resist film is not left in the gate terminal portion and the drain terminal portion.

[0055] Refer FIG. 5(A)

By employing the wet etching method using a hydrofluoric acid-based etching solution as an etchant, the channel protective film 26 is etched using the resist film 27 as a mask. It is to be noted that the channel protective film is not left in the gate terminal portion and the drain terminal portion.

[0056] Refer FIG. 5(B)

5-(2)

The resist film 27 used as a mask for etching the channel protective film 26 is peeled off. As a result, the channel protective film 26 is exposed.

[0057] Refer FIG. 6(A)

6-(1)

A source drain electrode material film 28 is formed over the whole surface. As this source drain electrode material, a conductive substance such as Al, Ti, or Cr can be used. Further, as a deposition technique, a vacuum evaporation method, a sputtering method, a CVD method, or the like can be employed.

[0058] 6-(2)

By employing the spin coating method, a resist film 29 is formed by applying a resist over the source drain electrode material film 28.

[0059] Refer FIG. 7(A)

7-(1)

By employing a resist process of the lithography technique, the resist film 29 is exposed and developed; thereby a drain electrode wire is patterned as a source electrode, a drain electrode, and a drain bus line. It is to be noted that the resist film is not left in the gate terminal portion.

[0060] Refer FIG. 7(B)

7-(2)

The source drain electrode material film 28 is etched using the patterned resist film 29 as a mask; thereby the source electrode 28S and the drain electrode 28D in the TFT portion and the drain electrode wire 28L is formed in the drain terminal portion. It is to be noted that the source drain electrode material film 28 is all removed in the gate terminal portion.

[0061] Refer FIG. 8(A)

8-(1)

The resist film 29 used as a mask for etching the source drain electrode material film 28 is removed by dipping it into a resist stripping solution or the like. As a result, the source electrode 28S, the drain electrode 28D, and the drain electrode wire 28L are exposed.

[0062] Refer FIG. 8(B)

8-(2)

By employing the CVD method, the passivation film 30 is formed over the whole surface. This passivation film 30 can be formed of SiN, SiO_2, or the like. It is to be noted that surface roughening treatment may be applied to the passivation film in a region corresponding to the pixel electrode in order to make a reflective electrode to be formed later be diffusely reflective.

[0063] Refer FIG. 9(A)

9-(1)

By employing the spin coating method, a resist is applied over the passivation film 30 to form a resist film 31.

[0064] Refer FIG. 9(B)

9-(2)

By employing a resist process of the lithography technique, the resist film 31 is exposed and developed; thereby an aperture 31A for forming a through hole to the source electrode is formed in

the TFT portion, an aperture 31B for forming a through hole to the gate electrode wire 22L is formed in the gate terminal portion, and an aperture 31C for forming a through hole to the drain electrode wire 28L is formed in the drain terminal portion.

[0065] Refer FIG. 10(A)

10-(1)

By employing the wet etching method using a hydrofluoric acid-based etching solution as an etchant, the passivation film 30 is etched using the resist film 31 as a mask; thereby a through hole 30A, a through hole 30B, and a through hole 30C are formed.

[0066] Refer FIG. 10(B)

10-(2)

The resist film 31 used as a mask for forming the through hole 30A, the through hole 30B, and the through hole 30C is removed by dipping it into a resist stripping solution or the like.

[0067] Refer FIG. 11(A)

11-(1)

A gate drain terminal material film 32 is formed over the whole surface. This gate drain terminal material film 32 may be formed of ITO (Indium tin oxide). Further, as a deposition technique, a vacuum evaporation method, a sputtering method, or the like can be employed.

[0068] The gate drain terminal material film 32 is patterned later. This is required for improving the strength of solder for connecting the gate terminal and the drain terminal to external elements.

[0069] Refer FIG. 11(B)

11-(2)

By employing the spin coating method, a resist is applied over the gate drain terminal material film 32; thereby a resist film 33 is formed.

[0070] Refer FIG. 12(A)

12-(1)

By employing a resist process of the lithography technique, the resist film 33 is exposed and developed; thereby a connecting electrode to the external elements in the gate terminal portion and a connecting electrode to the external elements in the drain terminal portion are patterned. It is to be noted that the resist film is not left in the TFT portion.

[0071] Refer FIG. 12(B)

12-(2)

The gate drain terminal material film 32 is etched using the patterned resist film 33 as a mask; thereby a connecting electrode 32G formed of an ITO film and a connecting electrode 32D are formed in the gate terminal portion and the drain terminal portion respectively.

[0072] In order to etch the gate drain terminal material film 32, a wet etching method using an anhydrous oxalic acid as an etchant, a dry etching method using $FeCl_2$ as an etching gas, or the like can be used.

[0073] Refer FIG. 13(A)

13-(1)

The resist film 33 used as a mask for etching the gate drain terminal material film 32 is removed by dipping it into a resist stripping solution or the like. As a result, the connecting electrode 32G and the connecting electrode 32D are exposed; however, nothing is left in the TFT portion. Therefore, the passivation film 30 having the through hole 30A only exists over the source electrode 28S.

[0074] Refer FIG. 13(B)

13-(2)

By employing the spin coating method, a resist is applied over the whole surface to form the resist film 34 with a thickness of about 8000 [Å].

[0075] Refer FIG. 14(A)

14-(1)

By employing a resist process of the lithography technique, the aperture 34A is formed by exposing and developing the resist film 34; thereby the through hole 30A which is formed in the passivation film 30 and exposes a portion of the source electrode 28S is exposed again. It is to be noted that the gate terminal portion and the drain terminal portion are covered with the resist film 34.

[0076] Refer FIG. 14(B)

14-(2)

By employing the vacuum evaporation method with the resist film 34 left, the reflective electrode film 35 formed of Al with a thickness of, for example, 5000 [Å] is formed. It is to be noted that the surface roughening treatment may be applied to at least a portion of the reflective electrode film

35 corresponding to the pixel electrode 14 in order to realize diffusive reflection.

[0077] As a technique to form the reflective electrode film 35, the sputtering method, the CVD method, or the like can be employed instead of the vacuum evaporation method. It is to be noted that the reflective electrode film 35 preferably has a thickness of 3000 [Å] or more. It is to be noted that as the resist film 34 is formed thick, step coverage of the reflective electrode film 35 is poor.

[0078] Refer FIG. 15

15-(1)

The resist film 34 is removed together with the reflective electrode film 35 by dipping it in a resist stripping solution or the like.

[0079] As a result, the reflective electrode 35R contacting the source electrode 28S is formed in the TFT portion. However, as all of the reflective electrode film 35 exists over the resist film 34 in the gate terminal portion and the drain terminal portion, the reflective electrode film 35 is all removed and the connecting electrodes 32G and 32D are exposed.

[0080] The TFT substrate manufactured in this manner is assembled with a counter substrate, liquid crystals, and the like to be a reflective type liquid crystal display device with no possibility of occurring corrosion and dissolution due to a battery effect.

[0081] FIGS. 16 and 17 are schematic sectional side views showing a TFT substrate at key points of steps for describing the steps of manufacturing the TFT substrate used for a reflective type liquid crystal display device of Embodiment 2 of the invention. Hereinafter, description will be made with reference to these views and the like. It is to be noted that the same symbols used in FIGS. 1 to 15 denote the same portions or have the same meanings.

[0082] Steps up to forming the structure of the TFT substrate shown in FIG. 16 are exactly the same as the steps of an embodiment of the invention describing FIGS. 1 to 13(A) except for forming the reflective electrode film 35; therefore, those views and descriptions are to be referred.

[0083] Refer FIG. 16(A)

16-(1)

By employing a resist process of the lithography technique, the aperture 34A and the aperture 34B are formed by exposing and developing the resist film 34. The through hole 30A which is formed

in the passivation film 30 and exposes a portion of the source electrode 28S is exposed again in the aperture 34A. It is to be noted that the gate terminal portion and the drain terminal portion are covered with the resist film 34.

[0084] Refer FIG. 16(B)

16-(2)

By employing the vacuum evaporation method with the resist film 34 left, the reflective electrode film 35 formed of Al with a thickness of, for example, 5000 [Å] is formed. It is to be noted that the surface roughening treatment may be applied to at least a portion of the reflective electrode film 35 corresponding to the pixel electrode 14 in order to realize diffusive reflection.

[0085] As a technique to form the reflective electrode film 35, the sputtering method, the CVD method, or the like can be used besides the vacuum evaporation method. It is to be noted that the reflective electrode film 35 preferably has a thickness of 3000 [Å] or more. It is to be noted that as the resist film 34 is formed thick, step coverage of the reflective electrode film 35 is poor.

[0086] Refer FIG. 17

17-(1)

The resist film 34 is removed together with the reflective electrode film 35 by dipping it in a resist stripping solution or the like.

[0087] As a result, the reflective electrode 35R contacting the source electrode 28S and the light shielding film 35C are formed in the TFT portion. However, as all of the reflective electrode film 35 exists over the resist film 34 in the gate terminal portion and the drain terminal portion, the reflective electrode film 35 is all removed and the connecting electrodes 32G and 32D are exposed.

[0088] The TFT substrate manufactured in this manner is assembled with a counter substrate, liquid crystals, and the like to be a reflective type liquid crystal display device with no possibility of occurring corrosion and dissolution due to a battery effect. Further, as malfunction of the TFT due to light leakage is suppressed by the light shielding film 35C, there is no need to form black matrix on the counter substrate side; thereby an aperture ratio can be improved.

[0089] In the invention, many other improvements can be realized in addition to the aforementioned embodiments. For example, although the surface roughening treatment was applied to make the reflective electrode film 35 be diffusively reflective, it may be arbitrarily

selected whether the roughening treatment is applied after the reflective electrode film 35 is patterned to be the reflective electrode 35R or the like.

[0090]

[Effect of the Invention] In a reflective type liquid crystal display device of the invention, when manufacturing a TFT substrate, a resist film is formed over the whole surface with a TFT portion covered with a passivation film in which a through hole which exposes a portion of a source electrode is formed, a gate terminal portion which exposes a connecting electrode, and a drain terminal portion which exposes a connecting electrode, an aperture of a reflective electrode pattern is formed by exposing and developing the resist film, a reflective electrode film is formed over the resist film, and a reflective electrode is formed which contacts the source electrode by peeling off the resist film together with the reflective electrode film thereover.

[0091] By employing the aforementioned structure, there is no possibility in that the resist film is developed with the reflective electrode film and the connecting electrode contacting each other. Therefore, corrosion and dissolution due to a battery effect do not occur even in the case where the reflective electrode film is formed of Al and the connecting electrode in the gate terminal portion and the drain terminal portion is formed of ITO. Thus, manufacturing yield of the reflective type liquid crystal display device which is controlled by TFT arrays is improved.

[Brief Description of the Drawings]

[FIG. 1] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 1 of the invention.

[FIG. 2] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 1 of the invention.

[FIG. 3] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 1 of the invention.

[FIG. 4] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device

display device of Embodiment 1 of the invention.

[FIG. 5] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 1 of the invention.

[FIG. 6] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 1 of the invention.

[FIG. 7] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 1 of the invention.

[FIG. 8] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 1 of the invention.

[FIG. 9] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 1 of the invention.

[FIG. 10] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 1 of the invention.

[FIG. 11] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 1 of the invention.

[FIG. 12] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 1 of the invention.

[FIG. 13] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 1 of the invention.

[FIG. 14] Schematic sectional side views showing TFT substrates at key points of steps for

describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 1 of the invention.

[FIG. 15] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 1 of the invention.

[FIG. 16] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 2 of the invention.

[FIG. 17] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing a TFT substrate used for a reflective type liquid crystal display device of Embodiment 2 of the invention.

[FIG. 18] FIG. 18 is a schematic plan view showing TFT substrate in a standard reflective type liquid crystal display device.

[FIG. 19] A schematic plan view showing an enlarged portion of a TFT region shown in FIG. 18.

[FIG. 20] Schematic plan views showing enlarged portions of the terminal shown in FIG. 18.

[FIG. 21] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing the TFT substrate described in FIGS. 18 to 20.

[FIG. 22] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing the TFT substrate described in FIGS. 18 to 20.

[FIG. 23] Schematic sectional side views showing TFT substrates at key points of steps for describing the steps of manufacturing the TFT substrate described in FIGS. 18 to 20.

[FIG. 24] A schematic sectional side view showing an enlarged portion surrounded by a dashed circle in FIG. 21.

[Description of Reference Numerals]

21: insulating transparent substrate, 22: gate electrode material film, 22G: gate electrode, 22L: gate electrode wire, 23: resist film, 24: gate insulating film, 25: active layer, 26: channel protective film, 27: resist film, 28: source drain electrode material film, 28S: source electrode, 28D: drain electrode, 28L: drain electrode wire, 29: resist film, 30: passivation film, 30A: through hole, 30B: through hole, 30C: through hole, 31: resist film, 31A: aperture for forming through hole, 31B: aperture for

forming through hole, 31C: aperture for forming through hole, 32: gate drain terminal material film, 32G: connecting electrode, 32D: connecting electrode, 33: resist film, 34: resist film, 35: reflective electrode film, 35R: reflective electrode, 35C: light shielding film, 35P: pin hole, 36: resist film

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